detection efficiency ($g1$) is approximately 10%, and the product of the extraction efficiency and amplification is between 17 and 20 photoelectrons (PEs) per ionized electron ($g2$) [33].

Different from the previous publications [10,32,34–36], we reblinded Run0 data and carried out a blind analysis of both datasets using an improved event building procedure, as detailed in Ref. [33]. The data selection combines two distinct event classes, the paired $S1$ and $S2$ signals (paired), as well as isolated unpaired $S2$ signals (US2). The paired data benefit from effective electronic recoil (ER) and nuclear recoil (NR) discrimination and three-dimensional position reconstruction capability, but at the cost of a higher energy threshold. Conversely, the US2 data allow for a lower energy threshold, but with the price of a higher background rate due to the absence of knowledge of the vertical position.

The basic dataset used in this analysis is the same as in the DM search [37] by excluding approximately 2.3 day (Run0) and 2.2 day (Run1) with unstable operation conditions. In addition, data periods of 5.5 days (paired) and 29.1 days (US2) are excluded due to abnormal $S1$ and $S2$ rates. As reported in previous work [10,32], a veto cut is applied to the time window after any signals exceeding 10 000 PE (see Ref. [33] for more details). For US2, an additional volume cut within an 80 mm radius cylinder surrounding the previous large $S2$ (> 20 000 PE) is also imposed. These measures are implemented to mitigate the "afterglow" effect, also known as delayed electrons [38–41] in the literature. The afterglow veto is optimized independently for the paired data and US2 data, resulting in an exposure loss of 23% (34%) and 26% (33%) in Run0 (Run1), respectively.

The ^{8}B candidate selection has three main steps: the data selection, the signal reconstruction, and the region-of-interest (ROI) selection. The data selection cuts for the paired and US2 data mostly follow those in Refs. [32,34]. For US2, the data selection cuts are further loosened to gain higher acceptance. The signal reconstruction refers to finding the correct paired and US2 data. For the paired data, inefficiency exists since some $S1$ and $S2$ could be mispaired due to the existing spurious $S1$s in the event window [32]. For the US2 data, the signal reconstruction follows that in Ref. [34] with negligible efficiency loss. The ROI for the paired data is defined by requiring $S1$ signals with two or three "fired" PMT hits and the raw $S2$ signals in the range between 60 to 300 PE. The ROI of the US2 data requires no isolated $S1$ signal with 2 or more hits in the event window, and the $S2$ corresponds to 4 to 8 ionized electrons. The $S2$ range is different from Ref. [34], to minimize the influence of the microdischarging (MD) background in the low-energy region (see later). The efficiencies of these three components, shown in Fig. 1, are estimated using the dedicated waveform simulation (WS) algorithm [42].

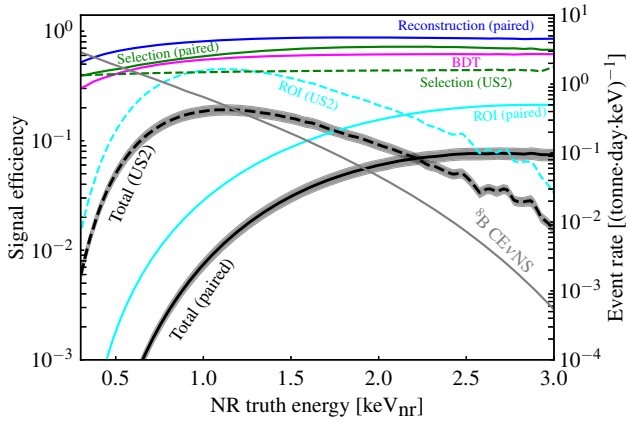

FIG. 1. All components of ^{8}B candidate selection efficiency for the paired (solid) and US2 (dashed) data: green, data selection; blue, signal reconstruction; cyan, ROI; magenta, BDT; black, total. The gray shaded regions indicate $\pm 1\sigma$ uncertainties. ^{8}B CEνNS signal spectrum is overlaid in gray with the scale indicated on the right axis. If using 1% efficiency as a threshold, the corresponding NR energy threshold for the paired and US2 are 1.1 and 0.33 keV, respectively.

The fiducial volume (FV) selections for Run0 and Run1 are separately optimized based on the background models in each run. For paired data, a radius cut of 520 mm is applied to both runs. For US2 data, we set a radius cut of 510 mm for Run0 and 520 mm for Run1. We also remove a cylindrical region within a radius of 250 mm in the upper-left corner (Fig. 2) in Run1 due to a number of dysfunctional top PMTs [37]. The fiducial masses of Run0 and Run1 are 2.58 (2.78) and 2.55 (2.16) tonne, respectively, for the paired (US2) data. In combination with the live time from each run, including the cylindrical afterglow

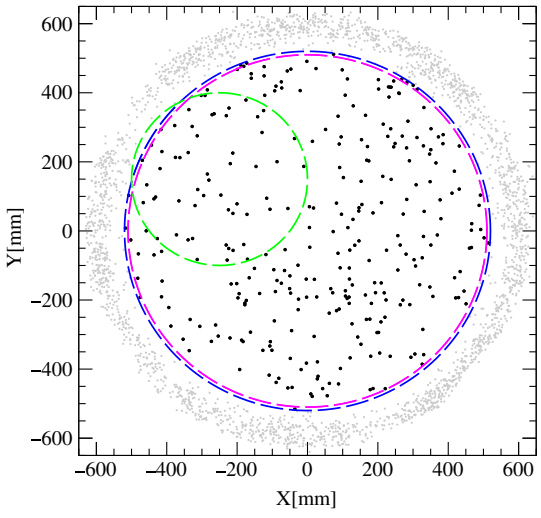

FIG. 2. Unblinded US2 data within (black) and outside (gray) the FV. The magenta and blue circles correspond to Run0 and Run1 FV circle cuts, respectively, and the green circle represents an additional cylindrical cut in Run1 due to dysfunctional PMTs.